REMARKS

The election of species requirement of June 25, 2003 requires an election of an ultimate species for each of components (A) and (C). As for component (A) Applicants elect impact polystyrene which is polybutadiene-modifed polystyrene, as seen from attached pages from the 90th Mid-October issue of Modern Plastics Encyclopedia. In addition, "Impact Polystyrene" is mentioned on page 16, line 2 of the specification. It is also seen from page 3, line 29, that an example of styrene polymer (A) is "elastomer-modified polystyrene", and on page 4, line 3, it is seen that a species of elastomer is polybutadiene.

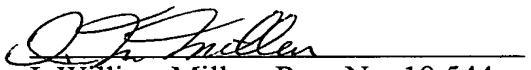
As for component (C), Applicants elect as the ultimate species ethylene-methyl acrylate-glycidyl(meth)acrylate terpolymer, described on page 16, line 12.

By inspection, it is seen that claims 24 and 25 are directed to sub-generic descriptions of the ultimate species of (A) and (C) and that claims 26 and 27 are directed to the ultimate species, with claim 28 being directed to the combination of the elected ultimate species.

In view of this election, an action on the merits of the application is respectfully requested.

The Commissioner is hereby authorized to charge any fees associated with this response or credit any overpayment to Deposit Account No. 13-3402.

Respectfully submitted,



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Attachment

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Modern Plastics

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90

Impact PS

By Anthony Poloso

Polystyrene is one of the oldest commercially produced thermoplastic polymers, dating back to the 1930s. Rubber modified versions (HIPS) were developed in the early 1950s to meet the needs for a tougher material. By introducing elastomers into the base polymer, many different HIPS grades can be produced with a wide range of properties. In recent years, specialty grades that can compete with more costly engineering resins in many applications have been developed. Flame-retardant, stress-crack-resistant, high-gloss, very high impact, glass-filled, and low residual volatile grades are now available.

HIPS resins are known for their ease of processing, good dimensional stability, impact strength, and rigidity. Normal limiting factors for HIPS are heat resistance, oxygen permeability, light (UV) stability, and oily chemicals resistance.

Chemistry and properties

Impact PS is generally produced by dissolving polybutadiene rubber in styrene monomer before polymerizing. Although HIPS can be produced by suspension polymerization, the major commercial process used today is mass or bulk polymerization. In the bulk process, the styrene monomer/rubber/additive mixture is fed through a series of reactors and reaches a conversion of 70 to 90%.

The reaction can be carried out thermally or by using initiators. The resin is then devolatized under high vacuum to remove residual monomer, and pelletized for sale. HIPS grades are generally classified according to their relative impact strengths, with medium-impact grades typically having notched Izod values of 0.6 to 1.5 ft.-lb./in., high-impact 1.5 to 2.5, and very high-impact greater than 2.5. Some grades are available with Izod values as high as 6.0, but these are generally used as blending resins to enhance the impact of lower-strength grades.

Other important properties of standard HIPS grades are flexural strength of 2000 to 8000 p.s.i.; tensile strength of 2000 to 6000 p.s.i.; elongation at break of 15 to 75%; specific gravity (density) of 1.035 to 1.04 g./cc.; and Vicat softening temperature of 185 to 220°F.

The only commercially significant alloy using HIPS is a blend with polyphenylene oxide. It offers improved heat resistance and toughness, but is significantly more expensive than HIPS alone.

Continuing developments in PS technology have allowed producers to introduce grades which have significantly enhanced properties compared to standard PS. Many properties—such as gloss and impact strength—are inversely related to each other, and fabricators have had to sacrifice gloss to improve impact strength. New resins now available can achieve the gloss level of ABS while maintaining excellent toughness. Grades that can resist many fats and oils for food packaging and CFC blowing agents in refrigeration applications also have been developed. Flame-retardant grades (UL, V-0 and 5-V) are also available and are widely used in television cabinets, business machines, and electronics. These materials process more easily and are lower in cost than many flame-retardant engineering resins.

Processing

Impact PS can be processed by many conventional processing technologies: injection molding, structural foam molding, sheet and film extrusion, thermoforming, and injection-blow molding. HIPS resins do not readily absorb moisture, and under normal conditions do not require drying. Occasionally enough surface moisture can be picked up to affect final part appearance. Drying for 2 to 3 hours at 160°F. will remove any excess moisture.

Extrusion of film, sheet, and profile is the single largest-volume process used for HIPS. Impact styrene's broad processing window makes it one of the easiest resins to thermoform. Conventional extrusion equipment is normally used at melt temperatures of 400 to 500°F. with resins that have melt flow rates in the 1.5 to 4.0 g./10 min. range. Both pressure and vacuum thermoforming are common, utilizing rotary, in-line, and shuttle equipment. HIPS has excellent thermal and shear stability and can tolerate high levels of regrind without lowering product performance. Regrind ratios as high as 60% are common in thermoforming operations.

Injection molding is the second largest volume process for HIPS. The resin is generally processed on reciprocating-screw machines having a length/diameter ratio of 16/1 to 24/1 and compression ratios of 2.5 to 3.0/1. Processing temperatures range from 350 to 500°F., but must be kept below 470°F. when processing flame-retardant grades, to prevent degradation of the additives. Resins designed for injection molding typically have a melt flow rate in the 5.0 to 15.0 g./min. range. Structural foam molding is also common, utilizing both chemical and physical blowing agents.

Although HIPS resins are compatible with one another, equipment should be purged before processing HIPS to insure good product integrity. Impact PS is not compatible with ABS, PVC, PE, PP, acrylics, or most other plastics. Mixing of incompatible plastics in processing equipment can cause delamination and a significant loss of physical properties.

Applications

Impact PS is used in many applications and industries because of its ease of processing, performance, and low cost. Major markets include packaging and disposables, appliances, consumer electronics, toys and recreation, and buildings.

The largest single us
aging and disposables,
packaging or food servic
tions include dairy conta
portion cups, lids, plate
posables such as flatwa
razors, and pens also
volumes of HIPS.

In recent years, pro
has focused on specialt
HIPS grades compete wit
ins in some applications
stantially upgraded prod
applications. One of th
pliances and consumer
growing market segmen
appliances, refrigerator li
ors, television cabinets,
components, business mac
and video cassettes. Speci
have replaced more-costly
ins in many of these applic

Commercial informati n

Production volume for HIPS
was approximately 2.4 bil
accounts for roughly half th
duced. This is approximat
than the previous year's pr
expected to enjoy an annual
5 to 6%/yr. for the next
which will keep producers o
above 90% of capacity. Th
major suppliers of impact PS
Amoco, Chevron, Dow, Fina
Mobil, and Polysar.

Standard impact PS grades
the 55, to 65¢ range and prov
cost/performance benefits as
with engineering and comm
such as polyolefins and PVC
and extrusion markets. □

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Expandabl P

By John G. Klepic

Expandable polystyrene is a ge
for polystyrene and styrene co
supplied as a compound with
blowing agents and other additi
can be processed into low densi
10.0 lb./cu. ft.) foamed articles.
common form of this product is
beads containing pentane as a
agent. The processing of EPS int
articles consists of several unique
is a unifying characteristic of a
category of plastic resins includin
able foam polyolefins and cop
EPS-type materials can make pro
diverse as a coffee cup, an energy
ing bumper for an automobile or
cu.-ft. foam block. Major end uses
are disposable drinking cups, cu
packaging, and thermal insulation.

Chemistry and properties

EPS is supplied as small particles, ty

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